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CURRENT LITERATURE.

BOOK REVIEWS.

Methods of ecological investigation.

ONE OF THE most important recent contributions to the literature of ecology is a work on the development and structure of vegetation, from the hand of Dr. CLEMENTS.¹ The object of this and a forthcoming volume is to present in a systematic and detailed manner the methods of ecological research that have been employed by the author for a number of years in the prairies and woodlands of Nebraska, and in the mountains of Colorado. The principles enunciated here were formulated as working hypotheses in 1898, and have since been submitted to rigorous field tests. The present paper deals in particular with the biological side of vegetation, while the forthcoming work is to be concerned more with the physical aspects.

The fundamental phenomena of vegetation are regarded as invasion and succession (dynamic), zonation and alternation (static), and association, the latter representing the stage to which vegetation has been brought. A section is devoted to each of these topics, and in each case there is given a historical survey of the phenomenon, followed by a keen analysis, and a bibliography. One may classify associations with relation to stratum, light, water, etc., but of these CLEMENTS strongly emphasizes the dominance of the water factor. He inclines not to accept SCHIMPER's edaphic and climatic associations, holding that all but submerged associations are both climatic and edaphic. Invasion consists of the movement (migration) and establishment (ecesis) of species. In discussing this topic, a number of terms are introduced applying to the plant member that migrates, the character of the contrivance which facilitates migration, and the agent involved. Polygenesis (theory of polytopic origin) is carefully analyzed, and the author fully accepts it as a valid theory. Successions are divided into primary (on new soil), and secondary (on denuded soil). Some excellent terms are introduced, indicating the direction of movement in the succession, xerotropic, mesotropic, and hydro-tropic, and their application is obvious.

The author gives laws of succession, which will be admitted at once in most cases, though it is likely that some may require modification. Zonation has been more fully considered by former authors than have the other topics treated here, but alternation is a phenomenon that has been discussed and developed only slightly except by Dr. CLEMENTS. Alternation is defined as the response of vege-

¹ CLEMENTS, F. E., The development and structure of vegetation. Botanical Survey of Nebraska. Studies in the Vegetation of the State, III. 8vo. pp. 175. Lincoln. 1904.

tation to the heterogeneity of the earth's surface, and is in sharp contrast to zonation as it is related to topographic asymmetry. A very interesting analysis is made of competition, which the author holds to be a physical factor in the last analysis.

This book is most difficult to review adequately, because of the great number of vital topics which are presented. The presentation is so logical and concise that a satisfactory review or summary would be little less than a verbatim reproduction of the work. The paper must be digested thoroughly from beginning to end by all who profess to be engaged in ecological research, and it should be studied by all botanists, especially those who think that ecology may not hope to deal with facts or have the logic or discipline of other lines of biology.—H. C. COWLES.

Leaf ecology.

HANSGIRG, who for a considerable time has been gathering data for such a work, has issued a somewhat elaborate volume on phyllobiology.² The aim of the author is to present the topic of the biology of the leaf, much as the biology of the flower has been presented in earlier works. Part I is devoted to a general consideration of leaf adaptations, especially those adaptations that may be called protective. Parts II and III make up the body of the volume, and present the biological classes or types of leaves.

Two general groups are recognized: the water and swamp leaf types of hydrophytes and halophytes, and the air leaf types of land plants. The former group has six subdivisions: the *Vallisneria* type adapted to currents, the *Myriophyllum* type adapted to standing water, the *Nymphaea* type of floating leaves, the *Isoetes* type, the *Lysimachia* (*Naumburgia*) type, and the *Calla* type. More than fifty types of air leaves are given, among which the following may be noted, so as to illustrate the method of the author: the violet type of shade leaf, the *Trientalis* type (wedge-shaped at base), the *Taraxacum* type of rosette leaves, the *Ipomoea* type of liana leaves, the *Cyclamen* type (reddish beneath), the *Begonia* type of velvety leaves, the *Ficus* type of gutter-pointed (dripping) leaves, the *Populus* type of trembling leaves, the *Allium* type of tubular leaves, the *Phragmites* type of weather-vane leaves, the conifer type of needle leaves, the *Eucalyptus* type of profile leaves, the grass type of involute leaves, the *Gnaphalium* type of hairy leaves, nyctitropic leaves, the *Mesembrianthemum* type of thick leaves, the *Carduus* type of spiny leaves, the *Drosera* type of insectivorous leaves. In each case there is a detailed description of the leaf type under consideration, together with a discussion of the ecological advantages of the type. The plants which illustrate the types are given in considerable detail.

Part III considers the same material, but the arrangement is by plant families and genera. Part IV considers the protective adaptations of young

² HANSGIRG, A., *Phyllobiologie nebst Uebersicht der biologischen Blatttypen von ein-und-sechzig Siphonogamenfamilien.* 8vo. pp. xiv + 486. figs. 40. Leipzig: Gebrüder Borntraeger. 1903. M12.